GAL,11 EO PROBE RELEASE AND ODM ATTITUDE DETERMINATION - "1'11 EORY, DEVELOPMENT & N] EAR-REAL-TIME MISSION OPIXA'1'1ONS*

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ABSTRACT

&<c~/faster and better, near-mal-time process for attitude determination of the Galileo (G1.1) spacecraft was developed, implemented, and utilized in G1.1's mission operations during its Probe Release on July 12, 1995 (95194) and Orbit Deflection Maneuver (ODM) on July 27, 1995 (9 S208).

For]'robe Release and ODM, the G].1, spacecraft was spun up to its high-spin state at 10.S rpm from its cruise low-spin state at 3 rpm, in order to achieve better spin stabilization. Prior to the spin-up, spacecraft attitude and wobble estimates were available from At titude and Articulation Control Subsyst cm (AACS). But post spin-up, through the duration till]'robe Release, and similarly for the ODM, these two vital spacecraft attitude data were unavailable.

While the Star Scanner remained functional in its collection of star pulse data, the on-board Attitude Determination flight software was not designed to generate star-based attitude 'estimates in the high-spin state. Nor could the gyros be used to provide attitude because the spacecraft was in an all-spin state.

In the absence of attitude telemetry (and attitude determination and control strategy) in the high-spin state, substantial simulation and analytical work was pcv-formed to ensure that the spin-up process minimally disturbed the spacecraft attitude and wobble. in-flight demonstration was also executed (as a secondary objective) during the 93070 Spin-Up Demo, to confirm the analytical prediction. For the Spin-Up Demo, Star Scanner star-transit data was collected and analyzed off-line via ground-based software.

With the advent and installation of the J]'], Advanced Multi-Mission Operations System AMMOS) in' G] 1. mission operations, more stream- lined processing of spacecraft telemetry data became a reality. Analysis results could be more readily attained in real-time and near-real-time. This is despite the slow bit rate (10 bps and less) in G1.1.'s 1 ow-Gain-Antenna outer-cruise operations (compared to the 1 %()() bps operations during the inner cruise, including 93070, operations).

Furthermore, there was a need to obtain attitude analysis results in a more t imely fashion than previous] y available, for the Probe Release and ODM.

A new near-rcd-titnc process, mro2 ATE (memory readout to attitude estimate), was developed to estimate the spacecraft attitude and wobble from Star Scanner star-transit data. This process and computer program set actually consisted of multiple programs called by several UNIX C-shell scripts. These multiple programs were partitioned and developed for specific purposes, some of which were repeatedly used for mission operations outside of this mro2ATE process, The scripting process can be likened to the "procedure-model-utilities" process adopted for the J]'] .'s Multi-Mission Spacecraft Anai ysis System (MSAS) for ground data analysis, inducting for the Cassini mission, targeted for launch in 1997.

'1 he theory and developmen t of the mro2ATE process wil 1 be described in this paper, The algorithm embodied in mro2ATE is.different in form, but almost identical in theory, from that in GI ,1. flight software (a Kalman estimate). It embodies a 'spherical geometry' analytical solution, which is visual and intuitive. Iterative and 'interactive application of mro2ATE also provides the optimal solution with respect to a l;igurc-of-Merit, which reflects the' goodness of fit of the solution. Comparisons between mro2ATE to previous ground analysis process(m) revealed its versatility and efficiency.

mro2ATE's successful near-rcai-tirnc application to GI.!'s Probe Release and ODM will also be described, consisting of the analysis of the following five data-sets:

(i) Pre-]'robe Release, data collected post spin-up on DOY 95193;
(ii) Post-Probe Release, data collected on DOY 95198;
(iii) Pre-ODM, Pre-WUB (Wake-Up-Burn), data collected on DOY 95203;
(iv) Pre-ODM, Post-WUB, data collected on DOY 95206;
(v) Post-ODM, data collected on DOY 95209.

All these data sets were **processed, ant] analysis results obtained, within** hours **of** data receipt. For the post-spin-up, prc-1'robe-l{elcasc, analysis results were derived two hours after data receipt in the early hours of DOY **95193.**

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